September 2005

FAIRCHILD SEMICONDUCTOR®

UniFET™

# FDAF69N25
# 250V N-Channel MOSFET

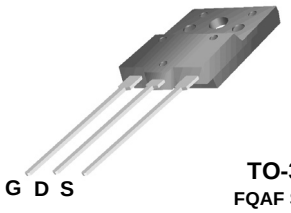
## Features

- 34A, 250V, $R_{DS(on)}$ = 0.041Ω @$V_{GS}$ = 10 V
- Low gate charge ( typical 77 nC)
- Low Crss ( typical 84 pF)
- Fast switching
- Improved dv/dt capability

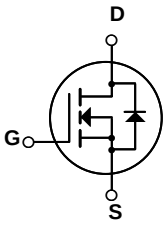
## Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switching DC/DC converters and switched mode power supplies.




**TO-3PF**
**FQAF Series**






## Absolute Maximum Ratings

| Symbol | Parameter | | FDAF69N25 | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 250 | V |
| $V_{DS(Avalanche)}$ | Repetitive Avalanche Voltage | (Note 1) (Note 2) | 300 | V |
| $I_D$ | Drain Current - Continuous ($T_C$ = 25°C)<br>- Continuous ($T_C$ = 100°C) | | 34<br>21.5 | A<br>A |
| $I_{DM}$ | Drain Current - Pulsed | (Note 1) | 136 | A |
| $V_{GSS}$ | Gate-Source Voltage | | ±30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 1894 | mJ |
| $I_{AR}$ | Avalanche Current | (Note 1) | 34 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | (Note 1) | 11.5 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 4.5 | V/ns |
| $P_D$ | Power Dissipation ($T_C$ = 25°C)<br>- Derate above 25°C | | 115<br>0.93 | W<br>W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | Min. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | -- | 1.08 | °C/W |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink | 0.24 | -- | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | -- | 40 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDAF69N25 | FDAF69N25 | TO-3PF | -- | -- | 30 |

## Electrical Characteristics $T_C$ = 25°C unless otherwise noted

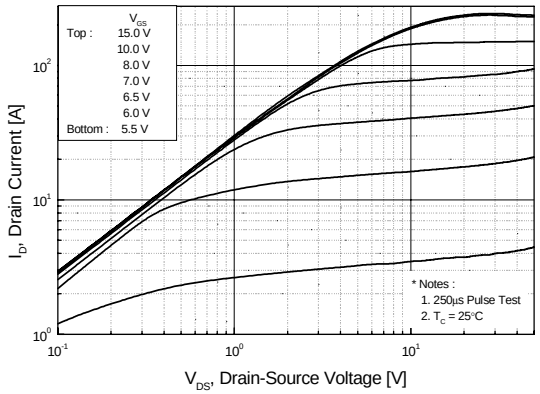
| Symbol | Parameter | Conditions | Min. | Typ. | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250μA | 250 | -- | -- | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250μA, Referenced to 25°C | -- | 0.25 | -- | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 250V, $V_{GS}$ = 0V<br>$V_{DS}$ = 200V, $T_C$ = 125°C | --<br>-- | --<br>-- | 1<br>10 | μA<br>μA |
| $I_{GSSF}$ | Gate-Body Leakage Current, Forward | $V_{GS}$ = 30V, $V_{DS}$ = 0V | -- | -- | 100 | nA |
| $I_{GSSR}$ | Gate-Body Leakage Current, Reverse | $V_{GS}$ = -30V, $V_{DS}$ = 0V | -- | -- | -100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 3.0 | -- | 5.0 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10V, $I_D$ = 17A | -- | 0.034 | 0.041 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40V, $I_D$ = 17A (Note 4) | -- | 25 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1.0MHz | -- | 3570 | 4640 | pF |
| $C_{oss}$ | Output Capacitance | | -- | 750 | 980 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 84 | 130 | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 125V, $I_D$ = 69A<br>$R_G$ = 25Ω<br>(Note 4, 5) | -- | 95 | 200 | ns |
| $t_r$ | Turn-On Rise Time | | -- | 855 | 1720 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 130 | 270 | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 220 | 450 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 200V, $I_D$ = 69A<br>$V_{GS}$ = 10V<br>(Note 4, 5) | -- | 77 | 100 | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 24 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 37 | -- | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 34 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 136 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 34A | -- | -- | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0V, $I_S$ = 69A<br>$dI_F/dt$ =100A/μs (Note 4) | -- | 210 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 5.7 | -- | μC |

**NOTES:**

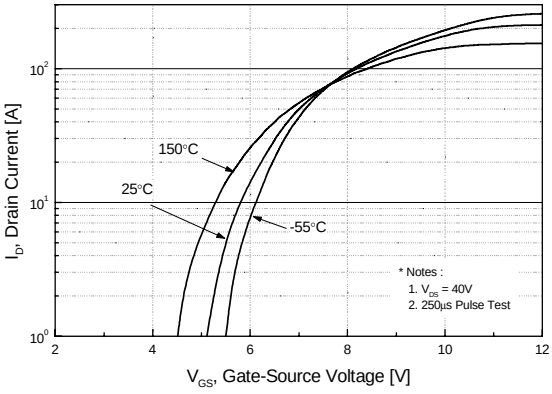
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L = 0.64mH, $I_{AS}$ = 69A, $V_{DD}$ = 50V, $R_G$ = 25Ω, Starting $T_J$ = 25°C
3. $I_{SD}$ ≤ 34A, di/dt ≤ 200A/μs, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

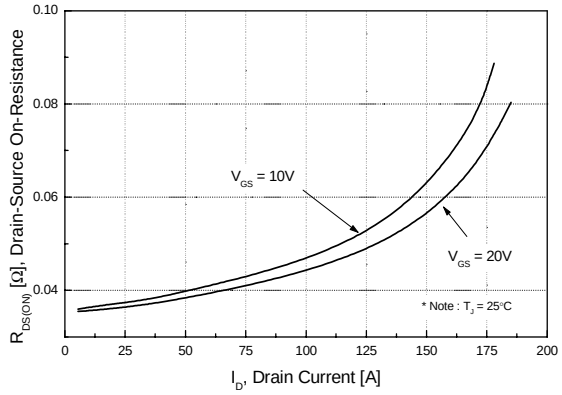
### Figure 1. On-Region Characteristics



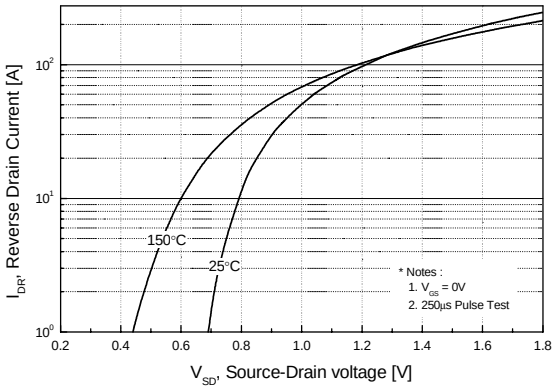

### Figure 2. Transfer Characteristics



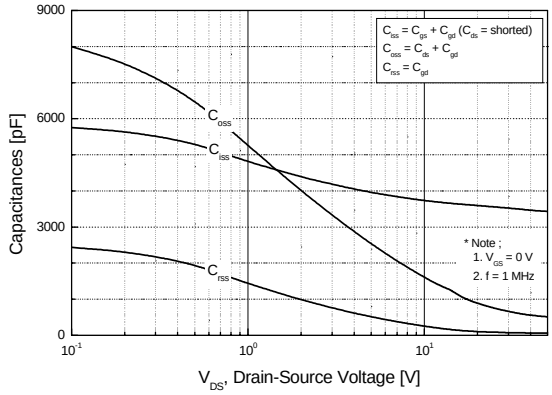

### Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage



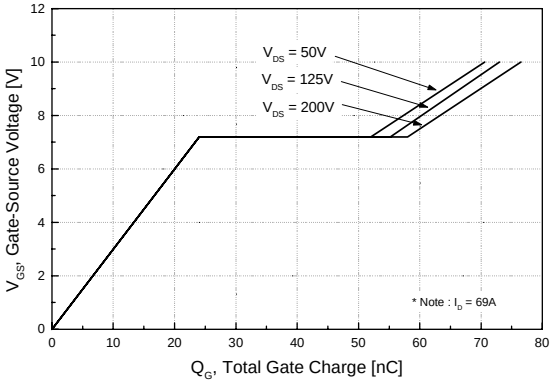

### Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue




### Figure 5. Capacitance Characteristics




### Figure 6. Gate Charge Characteristics



## Typical Performance Characteristics (Continued)

**Figure 7. Breakdown Voltage Variation vs. Temperature**

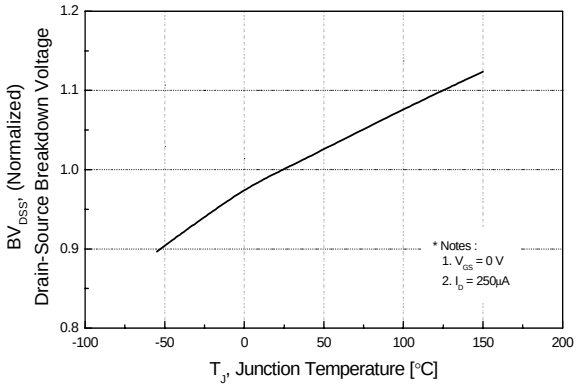



**Figure 8. On-Resistance Variation vs. Temperature**

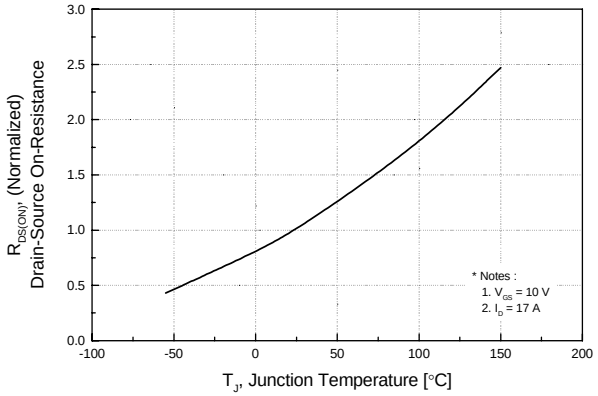



**Figure 9. Maximum Safe Operating Area**

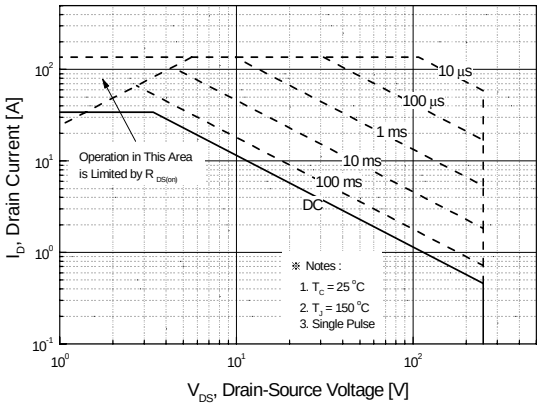



**Figure 10. Maximum Drain Current vs. Case Temperature**

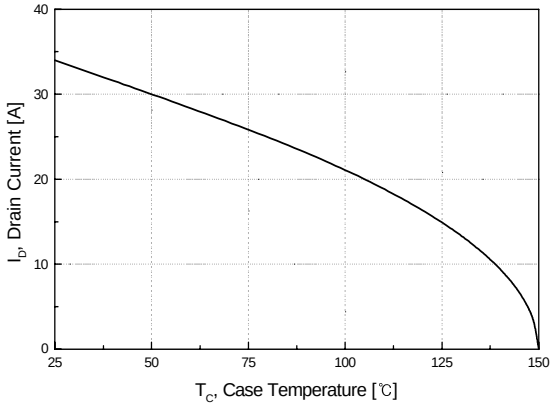
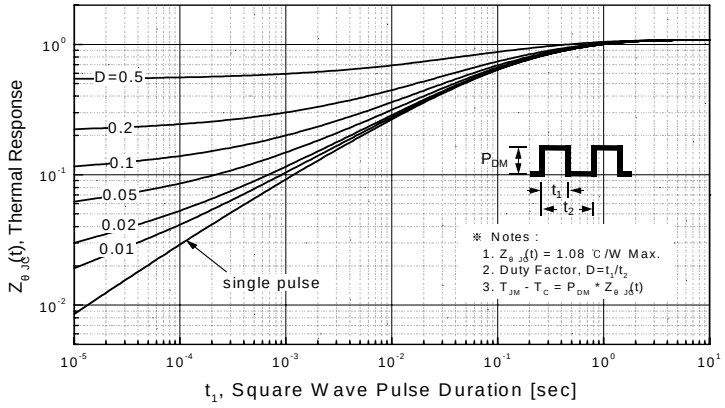
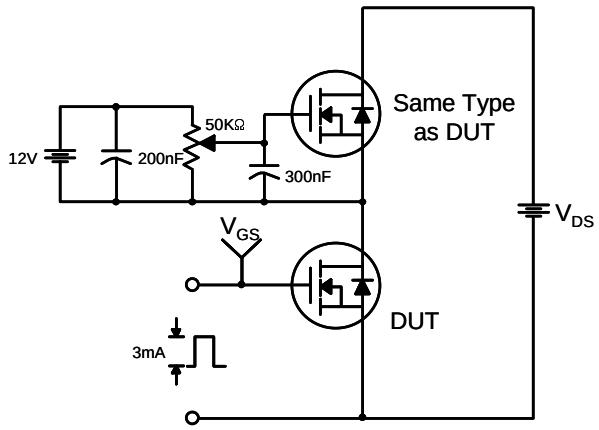
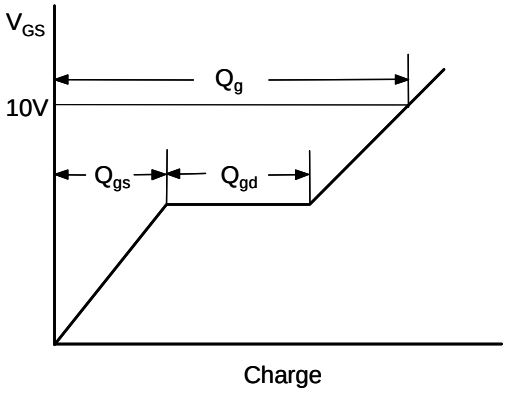



**Figure 11. Transient Thermal Response Curve**

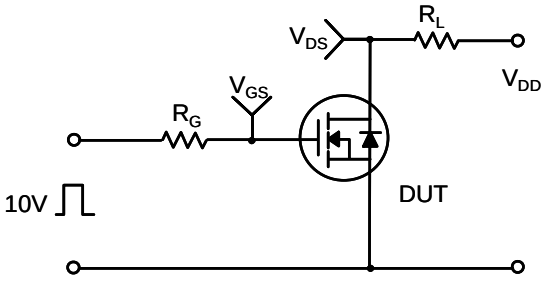


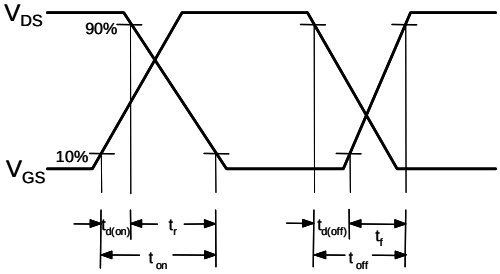
**Gate Charge Test Circuit & Waveform**



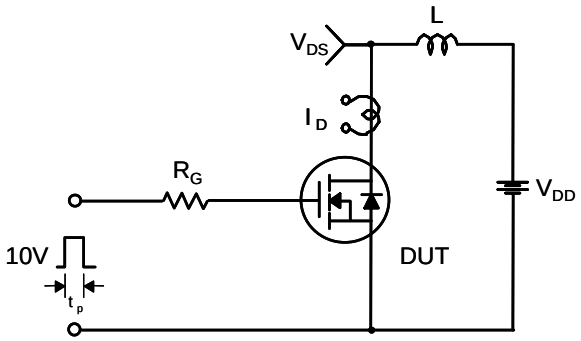




**Resistive Switching Test Circuit & Waveforms**

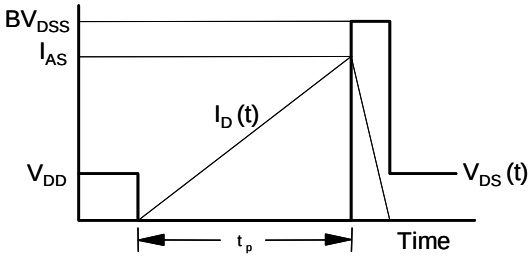


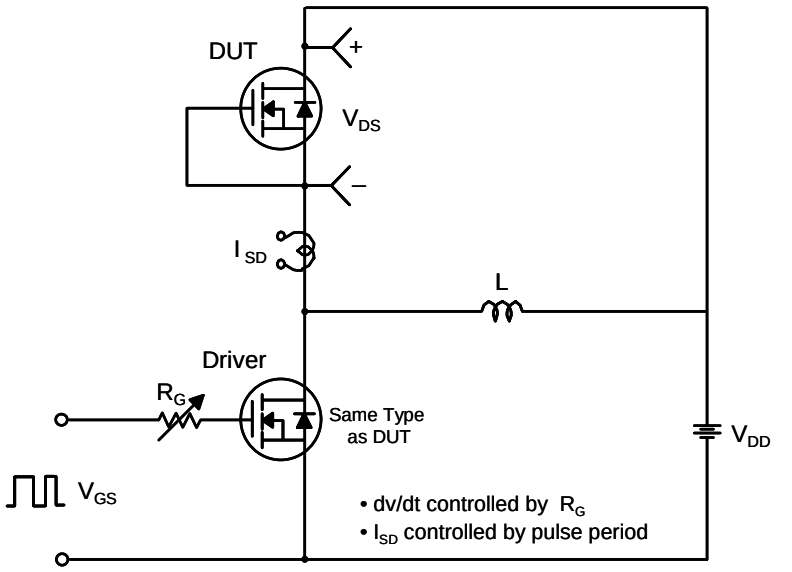

**Unclamped Inductive Switching Test Circuit & Waveforms**

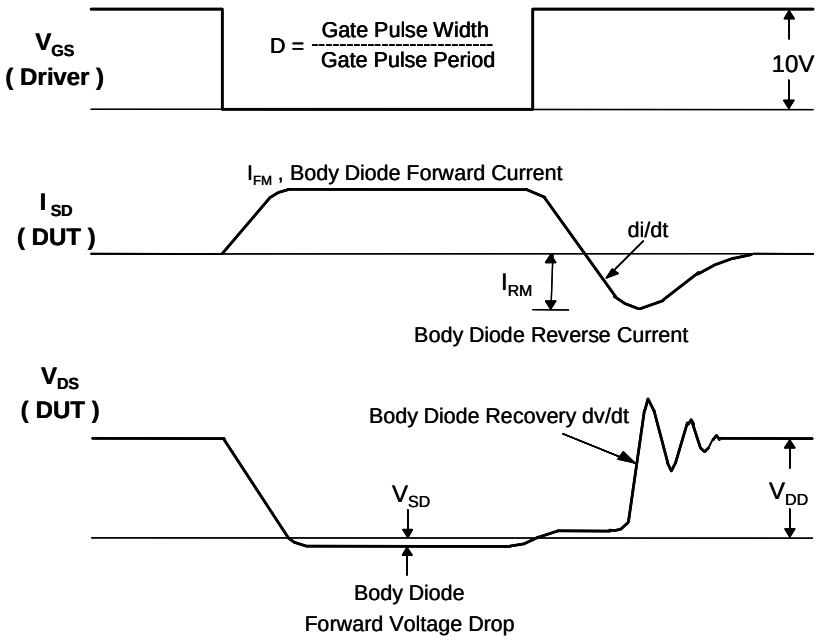



$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



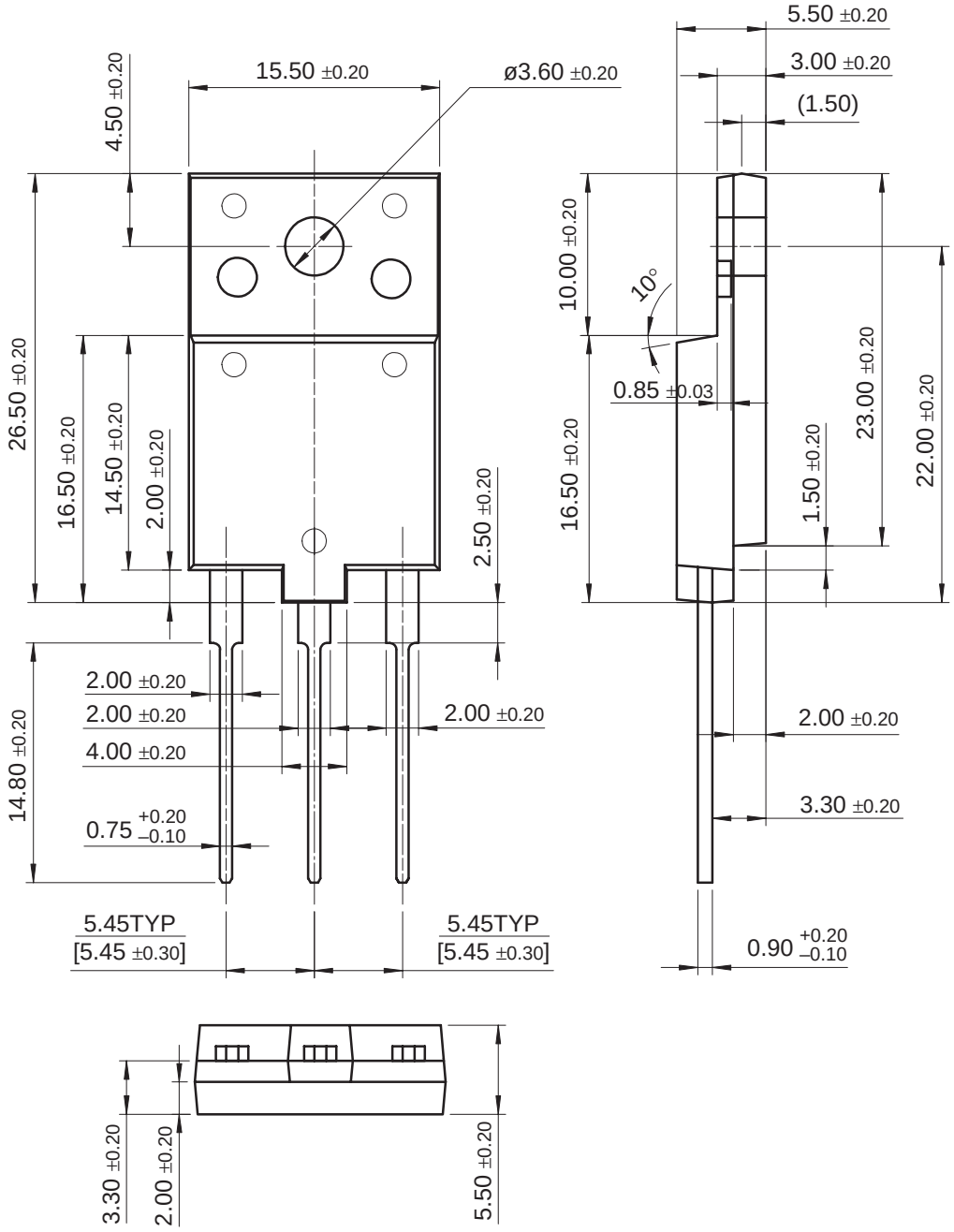
**Peak Diode Recovery dv/dt Test Circuit & Waveforms**



## Mechanical Dimensions

# TO-3PF




Dimensions in Millimeters

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